ARITHMETIC OPERATIONS INCLUDING DIVISION OF FRACTIONS

6TH GRADE

Lesson 16: Even and Odd Numbers

Classwork

Opening Exercise

What is an even number?

List some examples of even numbers.

What is an odd number?

List some examples of odd numbers.

What happens when we add two even numbers? Will we always get an even number?

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Exercises

Why is the sum of two even numbers even?

Think of the problem $12 + 14$. Draw dots to represent each number.

Circle pairs of dots to determine if any of the dots are left over.

Will this be true every time two even numbers are added together? Why or why not?

Why is the sum of two odd numbers even?

Think of the problem $11 + 15$. Draw dots to represent each number.

Circle pairs of dots to determine if any of the dots are left over.

Will this be true every time two odd numbers are added together? Why or why not?

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Why is the sum of an even number and an odd number odd?

Think of the problem $14 + 11$. Draw dots to represent each number.

Circle pairs of dots to determine if any of the dots are left over.

Will this be true every tie an even number and an odd number are added together? Why or why not?

What if the first addend was odd and the second was even. Would the sum still be odd? Why or why not? For example, if we had $11 + 14$, would the sum be odd?

Let's sum it up:

-
-
-

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Exploratory Challenge

Each group will determine on its poster paper whether one of the following products is odd or even: The product of two even numbers, the product of two odd numbers, or the product of an even number and an odd number. Use previous knowledge about even and odd numbers, the connection between addition and multiplication, and visual methods (e.g., dots) in your proofs.

The product of two even numbers is even.

The product of two odd numbers is odd.

The product of an even number and an odd number is even.

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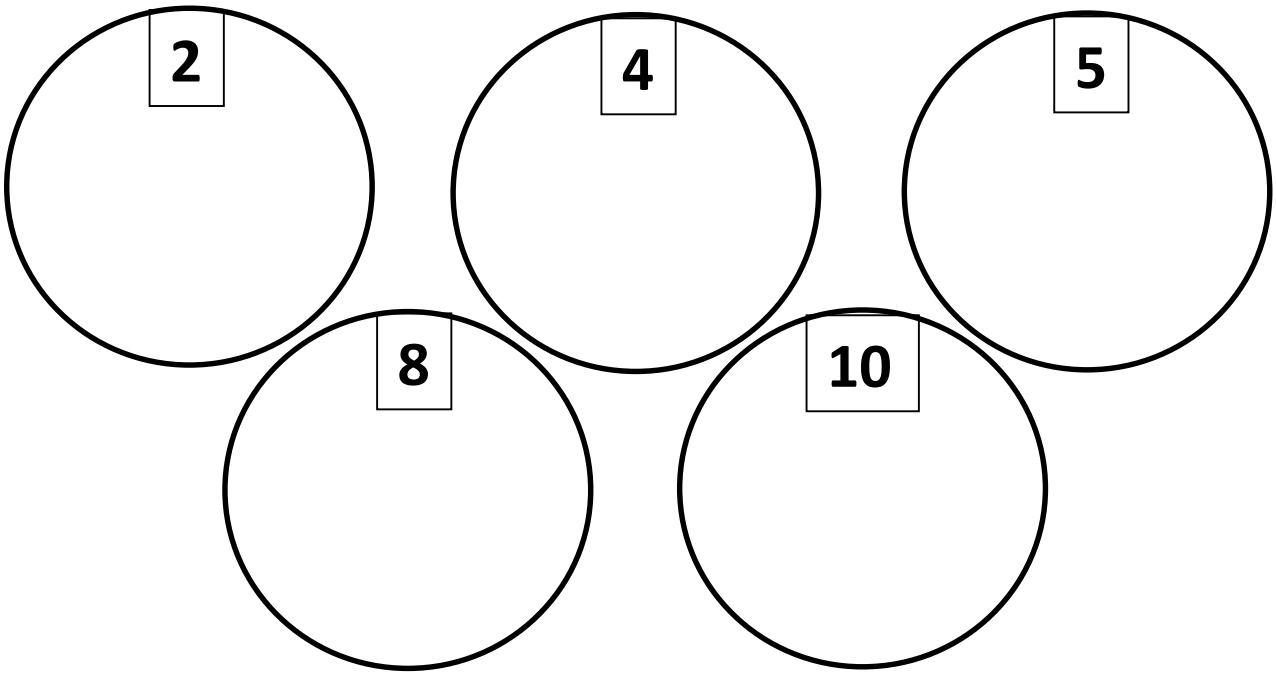
Lesson 17: Divisibility Tests for 3 and 9

Classwork

Opening Exercise

Below is a list of 10 numbers. Place each number in the circle(s) that is a factor of the number. You will place some numbers more than once. For example if 32 were on the list, you would place it in the circles with 2, 4, and 8 because they are all factors of 32.

24; 36; 80; 115; 214; 360; 975; 4,678; 29,785; 414,940



Discussion

- Divisibility rule for 2:
- Divisibility rule for 4:
- Divisibility rules for 5:
- Divisibility rule for 8:
- Divisibility rule for 10:

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Example 1

This example will show you how to apply the two new divisibility rules we just discussed.

Is 378 divisible by 3 or 9? Why or why not?

What are the three digits in the number 378?

What is the sum of the three digits?

Is 18 divisible by 9?

Is the entire number 378 divisible by 9? Why or why not?

Is the number 378 divisible by 3? Why or why not?

Example 2

Is $3{,}822$ divisible by 3 or 9? Why or why not?

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Exercises

Circle ALL the numbers that are factors of the given number. Complete any necessary work in the space provided.

1. Is $2{,}838$ divisible by

   3

   9

   4

   Explain your reasoning for your choices.

2. Is $34{,}515$ divisible by

   3

   9

   5

   Explain your reasoning for your choices.

3. Is $10{,}534{,}341$ divisible by

   3

   9

   2

   Explain your reasoning for your choices.

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4. Is $4{,}320$ divisible by

   3

   9

   10

   Explain your reasoning for your choices.

5. Is $6{,}240$ divisible by

   3

   9

   8

   Explain your reasoning for your choices.

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Lesson 18: Least Common Multiple and Greatest Common Factor

Classwork

The Greatest Common Factor of two whole numbers a and b, written $GCF\ (a, b)$, is the greatest whole number, which is a factor of both a and b.

The Least Common Multiple of two nonzero numbers a and b, written $LCM\ (a, b)$, is the least whole number (larger than zero), which is a multiple of both a and b.

Example 1

Greatest Common Factor: Find the greatest common factor of 12 and 18.

GCF $12, 18$

- Listing these factors as pairs can help you not miss any. Start with one times the number.
- Circle all factors that appear on both lists.
- Place a triangle around the greatest of these common factors.

12

18

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Example 2 (5 minutes)

Least Common Multiple: Find the least common multiple of 12 and 18.

LCM $12, 18$

Write the first $\mathbf{10}$ multiples of $\mathbf{12}$.

Write the first $\mathbf{10}$ multiples of $\mathbf{18}$.

Circle the multiples that appear on both lists.

Put a triangle around the least of these common multiples.

Exploratory Challenge 1: Factors and GCF

Choose one of these problems that have not yet been solved. Solve it together on your student page. Then use your marker to copy your work neatly on the chart paper. Use your marker to cross out your choice so the next group solves a different problem.

GCF $30, 50$

GCF $30, 45$

GCF $45, 60$

GCF $42, 70$

GCF $96, 144$

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Next, choose one of these problems that have not yet been solved:

a. There are 18 girls and 24 boys who want to participate in a Trivia Challenge. If each team must have the same number of girls and boys, what is the greatest number of teams that can enter? How many boys and girls will be on each team?

b. The Ski Club members are preparing identical welcome kits for the new skiers. They have 60 hand warmer packets and 48 foot warmer packets. What is the greatest number of kits they can prepare using all of the hand warmer and foot warmer packets?

c. There are 435 representatives and 100 senators serving in the United States Congress. How many identical groups with the same numbers of representative and senators could be formed from all of Congress, if we want the largest groups possible??

d. Is the GCF of a pair of numbers ever equal to one of the numbers? Explain with an example.

e. Is the GCF of a pair of numbers ever greater than both numbers? Explain with an example.

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Exploratory Challenge 2: Multiples and LCM

Choose one of these problems that have not yet been solved. Solve it together on your student page. Then use your marker to copy your work neatly on the chart paper. Use your marker to cross out your choice so the next group solves a different problem.

LCM $9, 12$

LCM $8, 18$

LCM $4, 30$

LCM $12, 30$

LCM $20, 50$

Next, choose one of these problems that have not yet been solved. Solve it together on your student page. Then use your marker to copy your work neatly on this chart paper. Use your marker to cross out your choice so the next group solves a different problem.

Hot dogs come packed 10 in a package. Hot dog buns come packed 8 in a package. If we want one hot dog for each bun for a picnic, with none left over, what is the least amount of each we need to buy?

Starting at 6:00 AM, A bus makes a stop at my street corner every 15 minutes. Also starting at 6:00 AM, a taxi cab comes by every 12 minutes. What is the next time there will be a bus and a taxi at the corner at the same time?

Two gears in a machine are aligned by a mark drawn from the center of one gear to the center of the other. If the first gear has 24 teeth and the second gear has 40 teeth, how many revolutions of the first gear are needed until the marks line up again?

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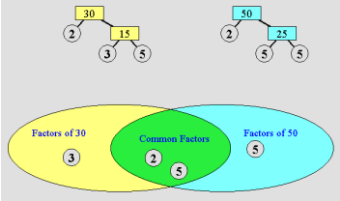
Is the LCM of a pair of numbers ever equal to one of the numbers? Explain with an example.

Is the LCM of a pair of numbers ever less than both numbers? Explain with an example.

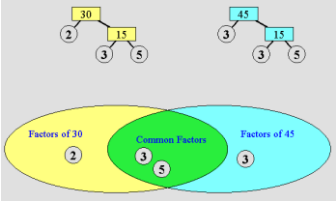
Exploratory Challenge 3: Using Prime Factors to Determine GCF

Choose one of these problems that have not yet been solved. Solve it together on your student page. Then use your marker to copy your work neatly on the chart paper. Use your marker to cross out your choice so the next group solves a different problem.

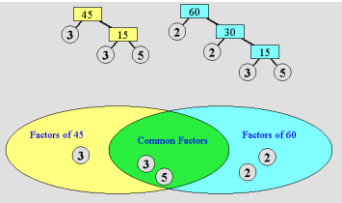
GCF $30, 50$



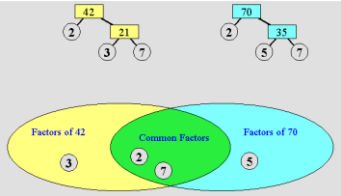
GCF $30, 45$



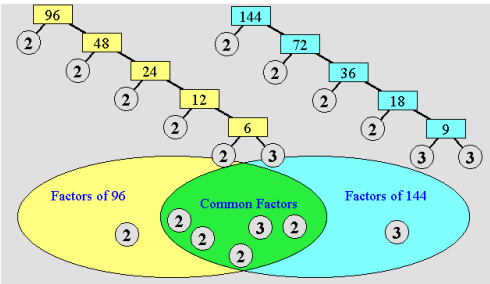
GCF $45, 60$



GCF $42, 70$



GCF $96, 144$



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Next, choose one of these problems that has not yet been solved:

Would you rather find all the factors of a number or find all the prime factors of a number? Why?

Find the GCF of your original pair of numbers.

Is the product of your LCM and GCF less than, greater than, or equal to the product of your numbers?

Glenn's favorite number is very special because it reminds him of the day his daughter, Sarah, was born. The factors of this number do not repeat and are all the prime numbers less than 12. What is Glenn's number? When was Sarah born?

Exploratory Challenge 4: Applying Factors to the Distributive Property

Choose one of these problems that have not yet been solved. Solve it together on your student page. Then use your marker to copy your work neatly on the chart paper. Use your marker to cross out your choice so the next group solves a different problem.

Find the GCF from the two numbers and rewrite the sum using the Distributive Property

1. $12 + 18 =$

2. $42 + 14 =$

3. $36 + 27 =$

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4. $16 + 72 =$

5. $44 + 33 =$

Next, add another new example to one of these two statements applying factors to the Distributive Property. Choose any numbers for n, a, and b.

$n(a) + n(b) = n(a + b)$

$n(a) - n(b) = n(a - b)$

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Lesson 19: The Euclidean Algorithm as an Application of the Long Division Algorithm

Classwork

Opening Exercise

Euclid's Algorithm is used to find the greatest common factor (GCF) of two whole numbers.

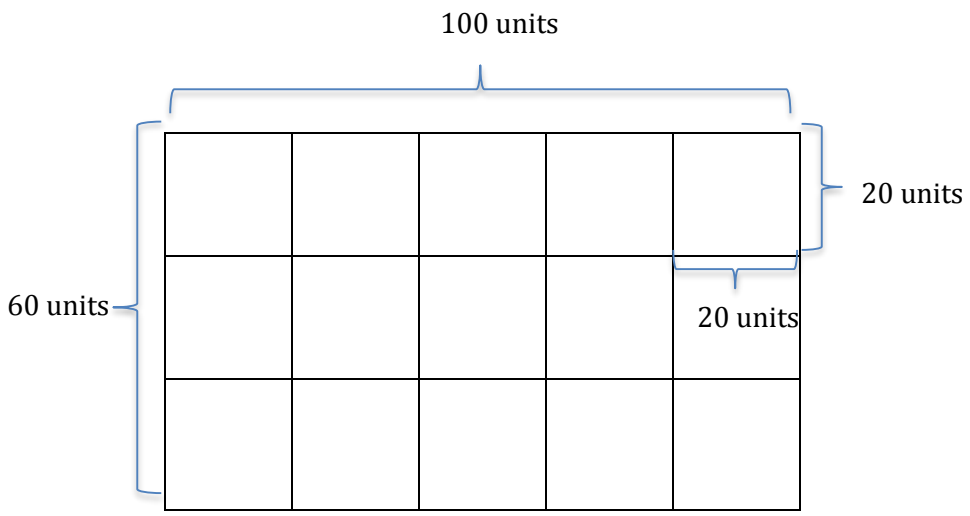
1. Divide the larger of the two numbers by the smaller one.
2. If there is a remainder, divide it into the divisor.
3. Continue dividing the last divisor by the last remainder until the remainder is zero.
4. The final divisor is the GCF of the original pair of numbers.

$383 \div 4 =$

$432 \div 12 =$

$403 \div 13 =$

Example 1: Euclid's Algorithm Conceptualized



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Example 2: Lesson 18 Classwork Revisited

Let's apply Euclid's Algorithm to some of the problems from our last lesson.

What is the GCF of 30 and 50?

Using Euclid's Algorithm, we follow the steps that are listed in the opening exercise.

What is the GCF of 30 and 45?

Example 3: Larger Numbers

$GCF\ (96, 144)$

$GCF\ (660, 840)$

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Example 4: Area Problems

The greatest common factor has many uses. Among them, the GCF lets us find out the maximum size of squares that will cover a rectangle. Whenever we solve problems like this, we cannot have any gaps or any overlapping squares. Of course, the maximum size squares will be the minimum number of squares needed.

A rectangular computer table measures 30 inches by 50 inches. We need to cover it with square tiles. What is the side length of the largest square tile we can use to completely cover the table, so that there is no overlap or gaps?

1. If we use squares that are 10 by 10, how many will we need?

1. If this were a giant chunk of cheese in a factory, would it change the thinking or the calculations we just did?

1. How many 10 inch × 10 inch squares of cheese could be cut from the giant 30 inch × 50 inch slab?

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Lesson 1: Interpreting Division of a Whole Number by a Fraction—Visual Models

Classwork

Opening Exercise

Draw a model of the fraction.

Describe what the fraction means.

Example 1

Maria has $\frac{3}{4}$ lb. of trail mix. She needs to share it equally among 6 friends. How much will each friend be given? What is this question asking us to do?

How can this question be modeled?

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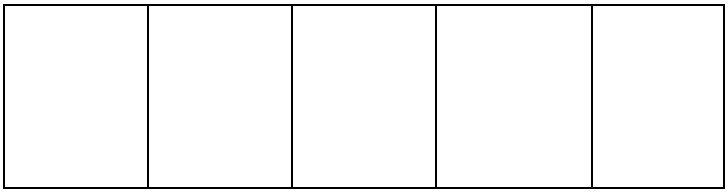
Example 2

Imagine that you have $\frac{2}{5}$ of a cup of frosting that you need to share equally between three desserts. How would we write this as a division question?

We can start by drawing a model of two-fifths.



How can we show that we are dividing two-fifths into three equal parts?

What does this part represent?

Exercises 1–5

For each question below, rewrite the problem as a multiplication question. Then model the answer.

6. $\frac{1}{2} \div 6 =$

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7. $\frac{1}{3} \div 3 =$

8. $\frac{1}{5} \div 4 =$

9. $\frac{3}{5} \div 4 =$

10. $\frac{2}{3} \div 4 =$

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Lesson 2: Interpreting Division of a Whole Number by a Fraction—Visual Models

Classwork

Example 1

Question #_____

Write it as a division question. _____

Write it as a multiplication question. _____

Make a rough draft of a model to represent the question:

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As you travel to each model, be sure to answer the following questions:

Original Questions	Write the division question that was answered in each model.	What multiplication question could the model also answer?	Write the question given to each group as a multiplication question.
11. How many $\frac{1}{2}$ miles are in 12 miles?			
12. How many quarter hours are in 5 hours?			
13. How many $\frac{1}{3}$ cups are in 9 cups?			
14. How many $\frac{1}{8}$ pizzas are in 4 pizzas?			
15. How many one-fifths are in 7 wholes?			

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Example 2

Molly used 9 cups of flour to bake bread. If this was $\frac{3}{4}$ of the total amount of flour she started with, what was the original amount of flour?

a. Create a model to represent what the question is asking for.

b. Explain how you would determine the answer using the model.

Exercises 1–5

1. A construction company is setting up signs on 4 miles of the road. If the company places a sign every $\frac{1}{8}$ of a mile, how many signs will it need?

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16. George bought 12 pizzas for a birthday party. If each person will eat $\frac{3}{8}$ of a pizza, how many people can George feed with 12 pizzas?

17. The Lopez family has adopted 6 miles of trail on the Erie Canal. If each family member cleans up $\frac{3}{4}$ of a mile, how many family members will be needed to clean the adopted section?

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18. Margo is freezing 8 cups of strawberries. If this is $\frac{2}{3}$ of the total strawberries that were picked, how many cups of strawberries did Margo pick?

19. Regina is chopping up wood. She has chopped 10 logs so far. If the 10 logs represent $\frac{5}{8}$ of all the logs that need to be chopped, how many logs need to be chopped in all?

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Lesson 3: Interpreting and Computing Division of a Fraction by a Fraction—More Models

Classwork

Opening Exercise

Draw a model to represent $12 \div 3$.

How could we reword this question?

Example 1

$\frac{8}{9} \div \frac{2}{9}$

Draw a model to show the division problem.

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Example 2

$\frac{9}{12} \div \frac{3}{12}$

Be sure to draw a model to support your answer.

Example 3

$\frac{7}{9} \div \frac{3}{9}$

Be sure to create a model to support your answer.

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Exercises 1–6

For the following exercises, rewrite the division problem. Then be sure to draw a model to support your answer.

1. How many fourths are in three fourths?

   Draw a model to support your answer.

   How are Example 2 and Exercise 1 similar?

   How are the divisors and dividends related?

   What conclusions can you draw from these observations?

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20. $\frac{4}{5} \div \frac{2}{5}$

21. $\frac{9}{4} \div \frac{3}{4}$

22. $\frac{7}{8} \div \frac{2}{8}$

23. $\frac{13}{10} \div \frac{2}{10}$

24. $\frac{11}{9} \div \frac{3}{9}$

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Lesson 4: Interpreting and Computing Division of a Fraction by a Fraction—More Models

Classwork

Opening Exercise

Write at least three equivalent fractions for each fraction below. Be sure to show how the two fractions are related.

$\frac{2}{3}$

$\frac{10}{12}$

Example 1

Molly purchased $\frac{11}{8}$ cups of strawberries. She eats $\frac{2}{8}$ in a serving. How many servings did Molly purchase?

Use a model to prove your answer.

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Example 2

Now imagine that Molly's friend Xavier purchased $\frac{11}{8}$ cups of strawberries and that he eats $\frac{3}{4}$ cup servings. How many servings has he purchased? Use a model to prove your answer.

Example 3

Find the quotient: $\frac{3}{4} \div \frac{2}{3}$. Use a model to show your answer.

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Exercises 1–5

A model should be included in your solution.

1. $\frac{6}{2} \div \frac{3}{4}$

2. $\frac{2}{3} \div \frac{2}{5}$

3. $\frac{7}{8} \div \frac{1}{2}$

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4. $\frac{3}{5} \div \frac{1}{4}$

5. $\frac{5}{4} \div \frac{1}{3}$

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Lesson 5: Creating Division Stories

Classwork

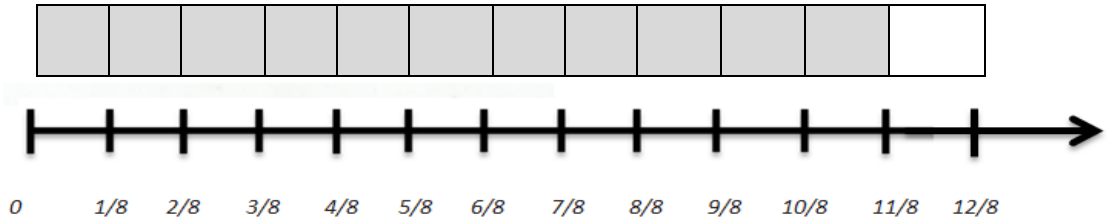
Opening Exercises

Fraction bar:

$\frac{8}{9} \div \frac{2}{9}$

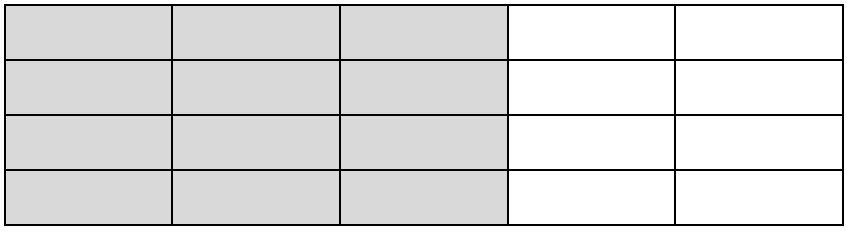
Number Line:

Molly's friend Xavier purchased $\frac{11}{8}$ cups of strawberries, and he eats $\frac{3}{4}$ cup servings. How many servings has he purchased?



Area Model:

$\frac{3}{5} \div \frac{1}{4}$



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Example 1

$\frac{1}{2} \div \frac{1}{8}$

Step 1: Decide on an interpretation.

Step 2: Draw a model.

Step 3: Find the answer.

Step 4: Choose a unit.

Step 5: Set up a situation.

Exercise 1

Using the same dividend and divisor, work with a partner to create your own story problem. You may use the same unit, but your situation must be unique. You could try another unit such as ounces, yards, or miles if you prefer.

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Example 2

$\frac{3}{4} \div \frac{1}{2}$

Step 1: Decide on an interpretation.

Step 2: Draw a model.

Step 3: Find the answer.

Step 4: Choose a unit.

Step 5: Set up a situation.

Exercise 2

Using the same dividend and divisor, work with a partner to create your own story problem. You may use the same unit, but your situation must be unique. You could try another unit such as ounces, yards, or miles if you prefer.

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Lesson 6: More Division Stories

Classwork

Example 1

Divide $50 \div \frac{2}{3}$

Step 1: Decide on an interpretation.

Step 2: Draw a model.

Step 3: Find the answer.

Step 4: Choose a unit.

Step 5: Set up a situation.

Exercise 1

Using the same dividend and divisor, work with a partner to create your own story problem. You may use the same unit, dollars, but your situation must be unique. You could try another unit, such as miles, if you prefer.

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Example 2

Divide $45 \div \frac{3}{8}$

Step 1: Decide on an interpretation.

Step 2: Draw a model.

Step 3: Find the answer.

Step 4: Choose a unit.

Step 5: Set up a situation.

Exercise 2

Using the same dividend and divisor, work with a partner to create your own story problem. Try a different unit. Remember spending money gives a "before and after" word problem. If you use dollars, you are looking for a situation where $\frac{3}{8}$ of some greater dollar amount is $\$45$.

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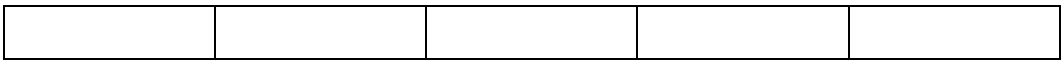
Lesson 7: The Relationship Between Visual Fraction Models and Equations

Classwork

Example 1

$\frac{3}{4} \div \frac{2}{5}$



Shade 2 of the 5 sections $\left(\frac{2}{5}\right)$.

Label the part that is known $\left(\frac{3}{4}\right)$.

Make notes below on the math sentences needed to solve the problem.

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Exercise 1

$\frac{1}{4} \div \frac{2}{3}$

Show the number sentences below.

Exercise 2

$\frac{2}{3} \div \frac{3}{4}$

Show the number sentences below.

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Lesson 8: Dividing Fractions and Mixed Numbers

Classwork

Example 1: Introduction to Calculating the Quotient of a Mixed Number and a Fraction

Carli has $4\frac{1}{2}$ walls left to paint in order for all the bedrooms in her house to have the same color paint. However, she has used almost all of her paint and only has $\frac{5}{6}$ of a gallon left. How much paint can she use on each wall in order to have enough to paint the remaining walls?

Calculate the quotient.

$$\frac{2}{5} \div 3\frac{4}{7}$$

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Exercise 1

Show your work for the memory game in the boxes provided below.

A.
B.
C.
D.
E.
F.
G.
H.
I.
J.
K.
L.

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Lesson 15: The Division Algorithm—Converting Decimal Division to Whole Number Division Using Mental Math

Classwork

Opening Exercise

Start by finding the quotient of $1{,}728$ and 32.

What would happen if we multiplied the divisor by 10?

What would happen if we multiplied the dividend by 10?

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What would happen if we multiplied both the divisor and dividend by 10?

What would happen if we multiplied both the divisor and dividend by 100?

What would happen if we multiplied both the divisor and the dividend by $1{,}000$, $10{,}000$ or $100{,}000$? What do you predict will happen?

How can we use this to help us divide when there are decimals in the divisor? How can we use this to help us divide 172.8 and 3.2?

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Example 1

Using our discoveries from the discussion, let's divide 537.1 by 8.2.

How can we rewrite this problem using what we learned in Lesson 14?

How could we use the short cut from our discussion to change the original numbers to $5{,}271$ and 82?

Example 2

Now, let's divide 742.66 by 14.2.

How can we rewrite this division problem so that the divisor is a whole number and the quotient remains the same?

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